TPRS

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Quarterly Report

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IN THIS ISSUE

President's Report

Tom McDermott, N5EG

Well, Hamcom 1997 has come and gone, and there have been some changes in TPRS. First of all, three of the five board members were up for election. Dan Puckett and Paul Guido chose not to run for another term, while Jim Neely decided to run again (some people never learn), and of course he was handily re-elected. Also, Bob Morgan and Tom McDermott decided to run, and were elected. All three of the new directors are elected for a two-year term, to expire in June of 1999. Our other two directors, Joe Borovetz, and Dave Wolf have terms that expire in June of 1998. During the first meeting of the new board Saturday night, Tom McDermott was elected President, Joe Borovetz was elected Vice President, Jim Neely re-elected treasurer, while Bob Morgan was elected secretary. Brad Smith was selected as the new newsletter editor. Additionally, Frank Aguilar has picked up responsibility for maintaining the TPRS membership database. The board would like to thank Charles Brabham for his efforts as the TPRS newsletter editor, a position he held for 2 years. Charles was very helpful

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TPRS Quarterly Report

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in putting out a nice newsletter. Additionally, we would like to thank Dave Wolf, who has been TPRS president for the last several years, for all the effort he put into TPRS. Dave did most of the work over the last two years, including maintaining the membership database, Hamcom program coordination, BBS coordination, and a few others I'm sure we will forget to mention here. Dave continues to provide assistance to TPRS – he's a real trooper.

Speaking of Hamcom, I attended the 1998 kick-off meeting on Saturday, August 9th. Attendance at Hamcom in 1997 was UP 20% over 1996. With the increase in attendance, Hamcom was able to pay off the accumulated debt from previous years, which is great news. The number of exhibitors was down 20% however, which should have been obvious. Overall, because of the smaller number of exhibitors, the main convention hall was not as crowded. Since 1996, the city of Arlington has assessed a $5.00 per car parking fee. In 1996, Hamcom added this to the price of the ticket. In 1997, the city collected a parking fee at the gate, and Hamcom did not add any parking fees to the ticket, which cost $9.00. Anyway, if you put lots of people in the car, you came out ahead, price-wise in 1997, if you came in- and out- of the parking lot several times, you came out behind. Hamcom 1998 has been scheduled, and will run Friday through Sunday, June 5,6,7, 1998 at the Arlington Convention Center. The TPRS digital programs were well attended again this year, and overall had really good attendance. I'd particularly like to thank all the program presenters this year for their efforts. Those presenting programs were:

Introduction to digital Modes – Dave Wolf, WO5H

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Introduction to Internet – Greg Jones, WD5IVD

Spread Spectrum – Greg Jones, WD5IVD, and Tom McDermott, N5EG

TexNet Network Update – Harry Ridenour, N0CCW

Automatic Packet Reporting System (APRS) – Mike Heskett, WB5QLD

DXing with 2-meter Packet – Presley Smith, N5VGC

Weather / NWS – Bob Morgan, WB5AOH

Radio Modifications – Joe Borovetz, WA5VMS

Channel Capacity – Tom McDermott, N5EG

Introduction to Digital Modes (Sunday) – Jim Neely, WA5LHS

BBS Forum – Hoss Karini, WA5ZAI

This is a good packet program session, and Hamcom always gets a lot of good compliments about the digital programs. It's probably the best digital program agenda of all the Ham conventions. Harry provides us a written update on the status of the TexNet network nodes in this issue. Harry is the network manger for TexNet, he finds lost nodes occasionally and puts them back into the routing table. Bob Morgan continues to add new features to the TexNet code, and you may have noticed that since he released version 1.7 of the code, that the network is more stable, and working better than ever. We'll try to convince Bob to write an update of all the neat stuff he is planning to shoe-horn into the new EPROMs.

The program on Spread Spectrum was very innovative, thanks to Greg Jones, who stayed up late Friday night (well, actually he never made it to sleep Friday, working well into Saturday past breakfast time). For the SS program, the slides were prepared on a computer and projected through a liquid crystal display on top of an overhead view-cell projector. Nothing new, you say? Well, actually, all of the slides were resident on a LINUX server in a different building from the program, they were not on the laptop computer. All of the slides were downloaded one at a time, in real time as displayed, through a spread-spectrum link from the LINUX server to the laptop computer in the program room. Many of the slides had very detailed color pictures embedded, and they all loaded instantly. So the whole program was displayed remotely! Greg did all of the HTML programming (and conversion of my slides from Powerpoint to HTML) the night (morning) before. The SS link worked great, we had no QRM problems. It was running 400 milliwatts on the 902-928 MHz ham band.

Speaking of Spread Spectrum, I continue to see phenomenal interest in SS at all the ham conventions. In Austin a week ago at Summerfest, I presented a one hour program on SS, and almost 100 people attended. The discussion centered on applications of spread spectrum, as well as some technical details. It's clear than many hams are interested in what SS can do for them. Besides the HTML demo that was shown at Hamcom, there are many uses for a high-speed data link. We'll talk about that in subsequent issues of the Quarterly Report. Elsewhere, you will find an article on a new amateur high-performance spread spectrum radio design that is being implemented by three members of TPRS: Bob Stricklin, Bill Reed, and myself. The Tucson Amateur Packet Radio Society (TAPR) is sponsoring this radio project, and the three of us are also TAPR members. Our first release of software for this radio is planned to provide a point-to-point link for Internet Protocol (IP) frames at faster-than-ISDN speeds. In future issues of the QR, we hope to have informational articles on IP, how it works, setting up

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servers and sites, etc. TPRS has one or two experts in the club, but if you have an interest in writing about computer networking, please send contributions to me (n5eg@tapr.org), or our newsletter editor Brad Smith (brads@galstar.com).

One last thing – the ARRL and TAPR are sponsoring the 1997 Digital Communications Conference October 10-12, in Baltimore. This is a great convention for the technically minded, but there are also great beginner- and intermediate- sessions for the more operationally oriented. You can find more details elsewhere in this issue of the QR.

TPRS Board Meeting minutes June 7, 1997

Board members present:
Tom McDermott, Jim Neely, Joe Borovetz, Bob Morgan.

Other TPRS members looking on and serving as barflies, observers, contributors and consultants included but not necessarily limited to:
Harry Ridenour, Clarke Diekmann, Greg Jones, Paul Guido.

Election of TPRS officers:

Nominated for President: Tom McDermott, N5EG
Nominated for Vice President: Joe Borovetz, WA5VMS
Nominated for Treasurer: Jim Neely, WA5LHS
Nominated for Secretary: Bob Morgan, WB5AOH
Motion made and seconded to close nominations and elect the above slate by acclaima-

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Texas Packet Radio Society, Inc.

TPRS was founded in 1985 and is an educational, public service, and scientific research non-profit corporation. Texas Packet Radio Society goals are:

1- design and research amateur radio packet networks
2- provide education in the area of general packet usage

To accomplish better communications in the region, TPRS has been organizing statewide working groups to cover various networking topics. The current working groups are the Mailbox/BBS Group, TCP/IP Group, and the TexNet Support Group. TPRS hopes that these working groups will help promote information exchange in their respected areas in Texas. New working groups are formed as needed to provide channels for discussion and to help provide direction for that area of digital communications. Anyone can participate in a working group; TPRS membership is not required.

TexNet

TPRS has established a digital packet network protocol, a standard hardware package for the network nodes, and software modules that implement the TexNet network.

The basic design philosophy of TexNet is an open, inexpensive, multi-resource, high speed 'backbone' with access through multi-connect capable local nodes. On the high speed side, TexNet is a 9600 baud network system. For local access, compatibility with the typical 2 meter AX.25, 1200 baud, AFSK/FM station is the operational norm. Other baud rates and modulation techniques can be supported on the primary user port or secondary port. The system is totally compatible with both versions of the AX.25 protocol specifications for user connections. With these general specifications, TexNet has been designed and tested to enable all users to take advantage of this high speed, full protocol protected packet network system.

Each node offers, in addition to TexNet access, local area digipeater service, 2 conference bridges for full protocol protected roundtable or net operation, a full mult-connect, multi-user mailbox system, a local console for installation and maintenance setups, a debugger module for long distance and local software monitoring,and an interface for a weather information server for regional weather information, if available.

The NCP-PC (TexNet for PC) creates a direct interface to the PC platform. The Z80 based PC card supports 4 channels for communications. This co-processor approach allows the AX.25 and TexNet-IP to run on the card without affecting the PC. This allows the full power of the PC to be used for network applications. The versatility of this board is only now being developed and applications are endless.

The TexNet Network

The Texas TexNet network system has been operational since October 1986. When fully operational, the network reaches from the border of Mexico to Missouri. Use of the Texas TexNet system is open to all amateur operators. TPRS has been coordinating the installation of the Texas TexNet system. Further expansion of the system depends entirely upon the amateur community.

INFORMATION

TPRS is interested in spreading our information and research efforts as widely as possible. We want other groups involved with packet efforts to get in contact with us. We will provide information for those amateur packet groups that are interested in this system for their areas. If you would like more information concerning TPRS or TexNet, please drop a letter to:

Texas Packet Radio Society, Inc.
P. O. Box 50238
Denton, Texas 76206-0238

TPRS MEMBERSHIP

TPRS membership is widespread with most members located in Texas, but members are located in other states and in foreign countries. Membership is open to any interested person. If you are interested in becoming a member and receiving the TPRS Quaterly, please send your name, address and call with membership dues of $12 per year. A membership application is available elsewhere in this issue.

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tion, passed by the board. The above list accepted as TPRS officers.

Appointments:
Named as Quarterly report newsletter editor: Brad Smith KC5SP
Named as mailing list database manager: Frank Aguilar N5SSH

BUSINESS:
1. TAPR affiliation approved.
- $25/year cost.
- Allows TPRS to sell TAPR items, and split revenues.
2. Modem Agreement between TAPR and TPRS:
- swap licenses to produce units:
- new 9600 modem to TAPR
- TNC-95 to TPRS
- Greg Jones to write agreement.
3. Austin Summerfest: We will get a table for Saturday, only.
(This date is Aug 2, as announced in Austin since the board meeting).
TPRS will present SS presentation, have table to sell memberships, CD-ROM, and Wireless book.
4. TPRS Fall Digital Symposium. Greg contributed the following info:
UT club to help. (Ken Harkin, Robert Barron). Date not yet planned.
5. HamCom wrap-up. Another good year.
6. Get database from Dave Wolf when it is properly updated and timed for handoff. Note: Dave has sent the database to Frank, who has sucessfully migrated it into Access'97.

OTHER BUSINESS:
7. Jim Neely will do TPRS web page updates- www.tprs.org
8. TexNet Map. Clarke Diekmann to learn HTML, do HTML file. Send file to Jim Neely.
9. Possible SS Radio Agreement between TAPR and TPRS discussed.
- Greg and Tom to discuss need, write one if necessary.
10. EPROM for APRS
- Bob Morgan code, performs APRS repeater function
- Retrofit EPROM into TNC95 to do APRS functions
- license Pacomm & TAPR to sell?
11. Board needs to discuss a long-range plan.

Bob Morgan WB5AOH
TPRS Secretary

TPRS Annual Business Meeting June 7, 1997

Paul Guido was official secretary at the time of the meeting.

1. Meeting called to order on June 7, 1997 at 12:10 PM by Dave Wolf, President.
2. Old business: Director terms were discussed. Mr. Wolf and Mr. Borovetz terms will expire in June 1998. The terms of Mr. Guido, Mr. Neely, and Mr. Puckett expire in June 1997, and those three directors positions are open for election as of this meeting.
3. Mr. Wolf made comment to express board's appreciation of Bob Morgan for his tireless support of TexNet.
4. Mr. McDermott made comment to thank Dave Wolf for his service to TPRS as president.
5. Nominations for Directors opened. Nominations received for: Jim Neely, Bob Morgan, Tom McDermott. No other nominations being

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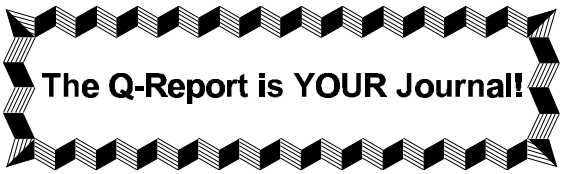

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received, it was moved by Dave Wolf and seconded by Joe Borovetz that the nominees be elected by aclimation. Voice vote passed.
6. Call for new business, none raised.
7. Meeting adjorned by Mr. Wolf at 12:30 PM.

- Paul

Treasurer's Report

The deposit prior to Hamcom weekend was $2593. TAPR was paid $980 for the merchandise on consignment and $85 for the TPRS postal permit written out of the wrong checkbook.

We started with $200 in change, so TPRS netted $1413 at Hamcom.

The TPRS bank account is now at a little under $4100. It is expected that Dave Wolf also has some expenses.

Jim Neely

jmneely@ibm.net or
wa5lhs@tapr.org

An Amateur 900 MHz Spread-Spectrum Radio Design
Part 1 of 2

Tom McDermott, N5EG,
n5eg@tapr.org,
Bob Stricklin, N5BRG,
n5brg@tapr.org,
Bill Reed, WD0ETZ, wd0etz@tapr.org

Abstract

System design principles and high-level design details are described for a new spread-spectrum radio design for the 900 MHz. Amateur band. The radio is designed to provide a 10-base-T interface as the data port, and is designed to provide transport of IP-based data. It is planned to provide both stand-alone and fully-networked hub configurations. The design is based on Frequency-Hopped Spread Spectrum (FHSS) spreading. Use of Forward Error Correction (FEC) and QPSK modulation should provide significant system gain performance compared to other FHSS FSK designs. The radio is currently in the printed-circuit board layout stage.

Introduction

Significant enhancement in the use and application of computer networking in the last 5 years has led to the need for high performance wireless interconnection of computers. Traditional 1200-baud and 9600-baud packet links are not able to provide adequate speed for today's web-based applications. Further, long-haul linking of multiple radios in linked configurations has proven difficult and unreliable. This can be seen from simple numerical analysis of the poor reliability of such multiple-hop configurations[1]. One solution to the reliability issue is to utilize other transport facilities for most of the transmission distance, such as the Internet.

In industry, wireless is valued greatly for the ability to provide mobility. Thus, fiber optics has replaced radio in the long-haul telephony networks (for most, but not all applications), and wireless is increasingly looked upon as a replacement for the wire copper loop. This inverts the traditional view of the wired and wireless domains[2].

Applications

A high-speed mobile data access infrastruc-

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ture to the Internet has many applications for the radio amateur, and could allow the provision of services and applications not possible with current commercial technologies. This is especially true as the Internet performance improves to support constant-bit rate multimedia services. Current audio coding technology provides quite acceptable audio at 13 kb/s. Videoconferencing is reasonably acceptable at 112 kb/s. Web browsing is possible at any speed, but only tolerable above 28 kb/s. A wireless interconnection technology that could support data rates in this range would provide the ability for the radio amateur to provide audio conferencing, via the Internet, from a mobile laptop computer to anywhere in the world in real time. Mobile laptop videoconferencing is similarly possible. Access to databases, maps, Email, etc., anywhere on the Internet in real time would make the utility of such a service very great. The radio amateur, equipped with such a capabilty could prove invaluable in many public-service scenarios. Indeed, the Internet not only addresses many of the problems of previous-generation packet networking, in fact it provides a powerful tool in its almost universal accessibility and rich diversity of information.

System Requirements

The design of a radio to meet the above applications is described. The general requirements are that the radio provide at least 128 kb/s throughput (more in other modes) while providing 20-mile coverage with 1-watt output power. 10-base-T was selected as the desired interface, and it is intended for connection to the LAN port of a laptop or other computer. It is envisaged that both a point-to-point configuration and a hubbed multi-point configuration would be supported. In the point-to-point configuration the radios would simply provide a transparent LAN interconnection pipe. For example, one radio might be connected to an Internet service, and located on top of a tall building, while the other end would be connected to a mobile laptop computer.

In the multi-point configuration, several radios are placed at a common site, such as a tall building. One channel becomes the control channel, and each of the remaining radios serves as a data channel. This provides for multiple users to simultaneously access the hub site. In the hub mode, all radios transmit and receive in synchronism. Additionally, good Internet connectivity might not be available at such a hub site, so individual data channels of the hub can be dedicated as fixed point-to-point links that provide a remote link to the Internet from the hub site. The radio design supports these configurations automatically with additional hardware. The control channel allocates access to idle data channels.

In the hub mode, the hub provides for dynamic assignment of IP addresses to the user computers via the DHCP protocol. This eliminates many of the difficulties of IP address administration in a mobile environment. However, it does not allow the user to move the computer from one node to another while connected. Instead the link will be broken and will have to be re-established with a new IP address.

Spreading Methods

Both Direct-Sequence Spread Spectrum (DSSS) and FHSS were studied. The Harris Prism™ chipset was initially investigated for such a radio. This chipset is designed to provide 802.11 wireless LAN for mobile laptop computers. However, this excellent chipset cannot easily provide the required system gain

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and performance required for a 20-mile link. It was intended to provide a low-cost low-power 1 Mb/s LAN interconnection primarily within a few 100's of feet. The Prism chipset utilizes DSSS modulation, and provides a spreading gain of only 12 dB. maximum, 11 dB typically. Further it is designed for the 2.4 GHz. band, which we felt would be difficult for average amateurs to equip with adequate antennas and feedline to meet the link distance requirement. We chose to implement the first radio design in the 900 MHz. Amateur band (902-928 MHz., a width of 26 MHz.) due to the availability of commercial components.

At first blush 20 dB of system gain (100:1 spreading ratio) within a 26 MHz wide band implies a maximum data rate of 26/(100*2) = 130,000 b/s. Since we also wanted the radios to operate half-duplex (to minimize cost), this maximum rate would be further reduced to 65,000 b/s. The data rate could be doubled if QPSK modulation is utilized, because it halves the spectral requirements. However, we noted in several spectrum analyzer sweeps of the 900 MHz band in Dallas, Texas that a large number of very strong narrow-band carriers are present. Testing with commercial part-15 radios indicated that these strong carriers render DSSS radios inoperative when the link distance was increased beyond one or two miles.

However, tests with FHSS radios under the same conditions proved to be more encouraging. Eventually, 20-mile links were achieved with one FHSS radio when the antennas were converted to horizontal polarization. Horizontal polarization reduced the amplitude of the interfering carriers by more than 20 dB. Thus an FHSS-based radio design was selected.

System Design Parameters

The parameters that were initially selected for the radio design are based on the availability of off-the-shelf SAW filters for the IF strip, what we felt was an achievable settling time for the frequency hopping VCO, available integrated circuits, and an aggressive but hopefully reasonable demodulator synchronization time. These parameters have been selected as follows:

Dwell time on each slot:	10 milliseconds
IF filter bandwidth:	600 kHz.
RF instantaneous bandwidth:	600 kHz.
RF channel bandwidth:	26 MHz.
Number of slots within band:	43
Modulation format:	QPSK, square-root raised-cosine roll-off
Forward Error Correction:	Convolutional, based on K=7 coder and Viterbi decoder. Code rate = 1/2 or 7/8 depending on mode.
Frame structure:	Based on HDLC frame
Demodulator:	Digital Costas-loop design
Modulation rate (all modes):	300 kilo-symbols/second
Transmit / Receive mode:	Time-Division Half-Duplex
Data throughput (mode 0):	150 kb/s (minus overhead)
Data throughput (mode 1):	300 kb/s (minus overhead)
Data throughput (mode 2):	~525 kb/s (minus overhead)

Continued next issue

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[1] A Primer on Reliability as Applied to Amateur Radio Packet Networks, T.C. McDermott, N5EG, 13th ARRL Digital Communications Conference proceedings, pp. 122-125

[2] This effect has sometimes been called the "Negroponte Inversion", after Nicholas Negroponte.

Telemetry in TexNet
Part 1

by Bob Morgan, WB5AOH, Austin

Remote Data acquisition, or telemetry, has come to TexNet.

I have retrofitted some prototype Analog to Digital Converters, commonly known as A/D's or ADC's, to a few of the nodes, and have some plans for a few more. They are ideal for nodes which are very inaccessible for maintenance and routine diagnostic visits. Moody is our most inaccessible node, being mounted on a platform several hundred feet in the air on a TV tower in central Texas, but there are some others that are either too far to routinely drive to, or access is so tightly controlled as to be extremely inconvenient to get at.

What are they used for? In packet node service, we very much would like to know some parameters from the radio equipment and the immediate environment. Most hams are accustomed to using an S-meter on a receiver which may also function as a transmit power or drive measurement on transmit. We can do that now on packet, and since there are no operators at nodes, we have to do it remotely. The converters are fast enough to be able to take snapshot readings of signal strength, frequency, deviation, or transmit power or drive during the active part of a packet transmission. To make it useful, we can track those readings back to the particular station which they came from. It is necessary to tightly couple the converter into the packet node itself to be able to accomplish the tight timing that is necessary to grab a reading during the packet, and also to be able to backtrack to the addresses in the packet, to associatethe readings with a callsign, so we have to attach the converter directly to the node CPU itself. Of course, that calls for some additional software in the node to do all of the work. I have made a few prototype boards that plug into the Z80 socket on the NCP or TNC2 that we use for the node, and also contains the A/D converter and the associated circuitry that makes it run, both digital decoding and gating functions for the converter, and the various analog conditioning and scaling circuits for the various inputs. The particular converter I am using is the ADC0817, which is a 40 pin IC, the same size as the Z80 itself, and can accept 16 inputs, one at a time, with an internal selector known as a multiplexer. Depending on its clock speed, it can convert a reading in 200 to 300 microseconds from the time it is commanded to start, to the time the reading is available to the CPU. Continued next issue

TexNet Network Status

As for the status of revisions across the network, 1.72 is considered standard issue, and 1.73 is identical except for a tweak used at PMS nodes. V1.74 is installed at a few nodes, and it wasn't a big enough of an advantage to whosesale change out at all nodes. V1.75 is being betatested, and when it is ready, contains some new fixes and features, and we will want to retrofit it into all nodes except those supporting a PMS disk (it won't run disk drives). It will be of particular interest to nodes supporting DXC's, since it should fix some errors we have with DXC connections, but remember it is still under test and revision, it isn't out yet. DXC nodes, and west Texas wireline nodes will need priority attention to change to this software as early as possible. (We hope that it is all out by publication time though). There is also a hardware retrofit to the wireline modems on the west Texas wireline, and it will greatly improve circuit performance, as we get more nodes retrofitted. Some of them have been shipped out.
-Bob

Call for Papers

1997 ARRL and TAPR Digital Communications Conference October 10-12, 1997 Baltimore, Maryland (minutes from BWI airport)

Web: http://www.tapr.org/dcc

It's that time again! Time to mark your calendar and think about what to publish for the upcoming 16th Annual ARRL and TAPR Digital Communications Conference.

The 1997 ARRL and TAPR Digital Communications Conference will be held October 10-12, 1997 in Baltimore, Maryland. This year's conference location is just minutes away from the BWI (Baltimore/Washington International) Airport.

For full details on the conference see http://www.tapr.org/dcc or contact the TAPR office for the DCC information flyer.

Call for Conference Proceeding Papers

Anyone interested in digital communications is invited to submit a paper for publication in the Conference Proceedings. Presentation at the Conference is not required for publication. If you know of someone who is doing great things with digital communications, be sure to personally tell them about this! Papers are due by August 20th, 1997, and should be submitted to Maty Weinberg, ARRL, 225 Main Street, Newington, CT 06111 or via the Internet to lweinberg@arrl.org. Information on paper submission guidelines are available on-line (http://www.tapr.org/dcc). Submissions can be e-mailed.

Contact TAPR to register of for more information on the DCC.

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Submissions for the Quarterly Report:

Brad Smith KC5SP
brads@galstar.com
Or by mail to the TPRS address on page 2.

TPRS Membership Application

Name _____ Callsign _____
Address _____
Apt. or Mailstop _____
City/State _____
Zip _____ E-mail address _____
Evening Phone ( ) _____ Work Phone ( ) _____

Membership is $12 per year. How many years are you paying for? ____

☐ New Member ☐ Renewal

Make check payable to: Texas Packet Radio Society

FOLD HERE

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ATTN:
Membership

Texas Packet Radio Society
P.O. Box 50238
Denton, Texas 76206-0238

Texas Packet Radio Society, Inc.

Be sure to visit the TPRS web page:
http://www.tprs.org
for the latest information on TPRS activities.

A current listing of Packet nodes, frequencies, and networks is located in the **North American Digital Systems Directory (NADSD) on-line at:**
http://www.tapr.org/directory/index.html

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